Digital Fiber-Optic Sensors

HPX-AG Series

Easy operation and high performance for a variety of applications

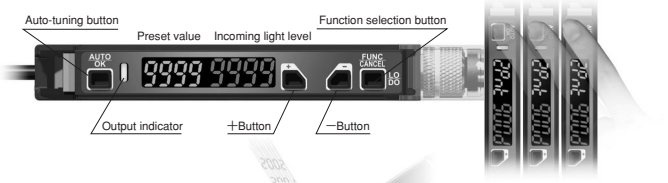
- **Dual display shows incoming light level and preset value side by side.**
- **High sensitivity and ultra long distance (1,200mm with the standard HPF-T003 thru scan fiber in high power mode)**
- **Three types of auto-tuning: 2-point, BGS and %**

EXPLANATION OF MAJOR FUNCTIONS AND FEATURES

Easy-to-use design

●Dual display panel

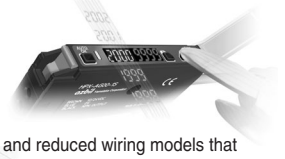
The digital dual display panel indicates incoming light level and preset value side by side, so it is easy to check current scanning status while setting the sensor. The button layout is especially designed to ensure easy operation of gang-mounted sensors.



●Easy operation

Digital manual tuning

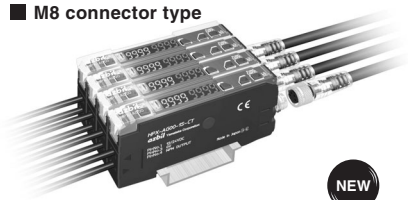
With controls that are as easy to operate as a conventional potentiometer, and with easy-to-read digital display, settings can be changed directly in RUN mode.



●Less wiring, fewer man-hours

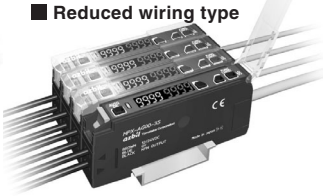
The new models offer a choice between cable lead-out, M8 connector for fast installation, and reduced wiring models that receive power directly from adjacent gang-mounted units. Up to 16 units can be gang-mounted, with only the main unit wired to the power supply.

■ M8 connector type



NEW

■ Reduced wiring type



Units are designed so that connecting cable is not required. There are no worries about wiring mishaps when mounting or dismounting.

Wiring with an M8 connector cable

Add 1 sensor— save 2 wires!

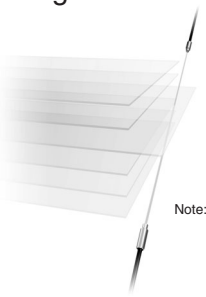
Since power is supplied through the gang-mounting connectors, only an output wire is required for the expansion units.

NEW

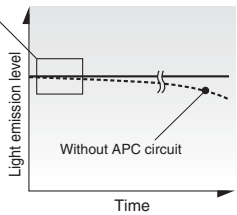
●Four-element LED make light and APC emission level twice as stable.

Long and short term stabilization

Four-element LEDs shine brightly longer than conventional LEDs. Furthermore, Auto Power Control (APC, light emission level control) monitors the level of light emitted by the LED, and regulates the current to maintain light emission at a constant level.



Stability when power is first supplied is also improved.

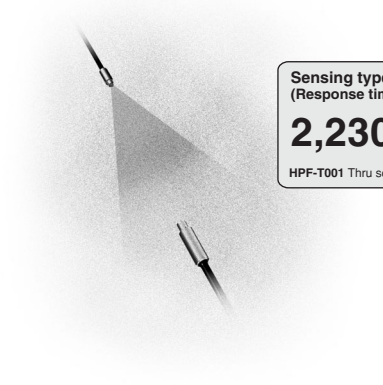


Note: APC controls the light emission level of the LED emitter, but does not compensate for a drop in received light level due to other factors.

Advanced scanning performance for expanded possibilities

●High sensitivity and ultra long distance

High-level performance is achieved with the built-in APC.



Sensing type: HP3
(Response time: 5ms)

2,230mm

HPF-T001 Thru scan fiber unit

●Five selectable sensing modes

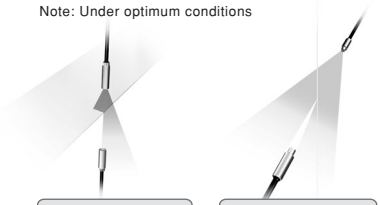
Five sensing modes are selectable by desired response speed and sensitivity, according to what is best for your application.

High sensitivity	Sensing mode	Response speed	Maximum
	HP (high power)	5ms	9999
	nL (normal)	1ms	9999
	SF (semi-fast)	500μs	5000
	FT (fast)	250μs	4000
High speed	HS (high speed)	50μs	4000

Long distance and high sensitivity modes: Setting in 1-digit increments is possible.

●High accuracy detection

Note: Under optimum conditions



Repeatability
±5μm or less (4σ)

With 1mm core dia.
HPF-T003 standard fiber unit

Smallest detectable object: 5μm dia.

With 1mm core dia.
HPF-T003 standard fiber unit

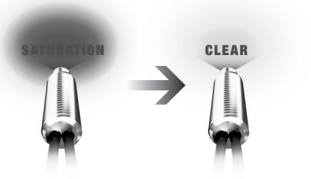
Detectable displacement 20μm or less

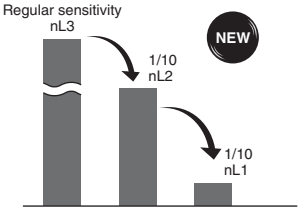
With **HPF-D034** coaxial fiber unit

●Countermeasures for short-distance saturation

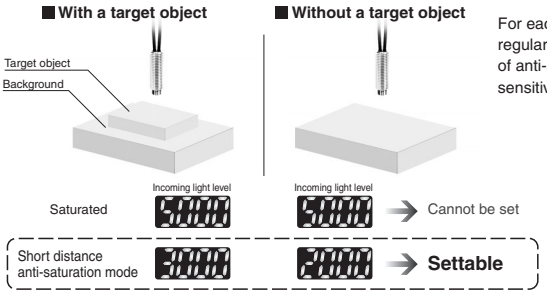
Sensitivity adjustment up to 1/100

New countermeasures have been added since the sales release of the **HPX** Series. Even for small difference detection at short distances or for a high reflection ratio on both target object and background, **HPX** sensors deliver reliable detection performance.



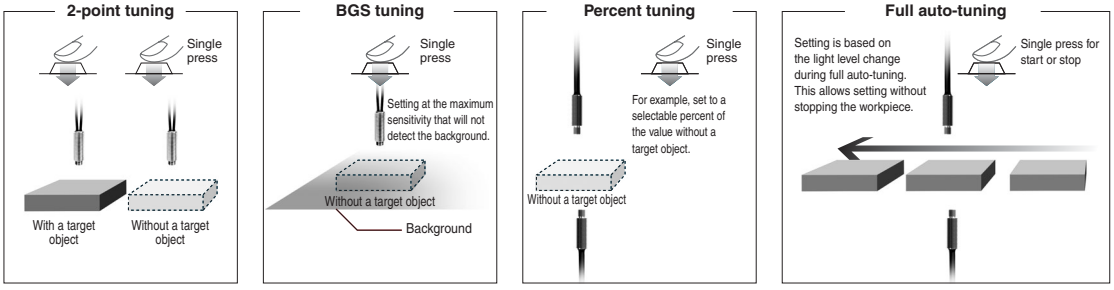


For each sensing type, both regular sensitivity and 2 modes of anti-saturation short-distance sensitivity.



●Superior auto-tuning

Incorporates not only standard 2-point tuning, but also BGS tuning (which allows setting without a target object), percent tuning and full auto-tuning.



Some models do not have full auto-tuning. For details, refer to the user's manuals.

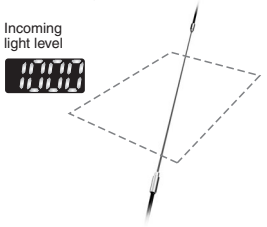
Easy-to-use design

●Easy auto-tuning Patent Pending

Percent (%) tuning —— For re-tuning on the same application, simply press the AUTO button in the % tuning setting mode.

Fewer tuning man-hours | **Fewer detection errors due to setting variations**

With a target object



Without a target object

Example: % tuning at 95%

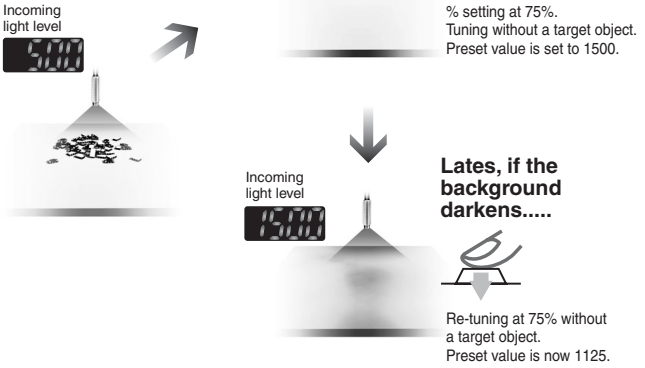
For the same environment or target object, the ratio of two tuning levels with and without a target object is approximately the same.

The setting range for % tuning without a target object is 10 to 999%.

Easy re-tuning

Detection of remaining chips.....

Setting can be based on the background with no chips present.



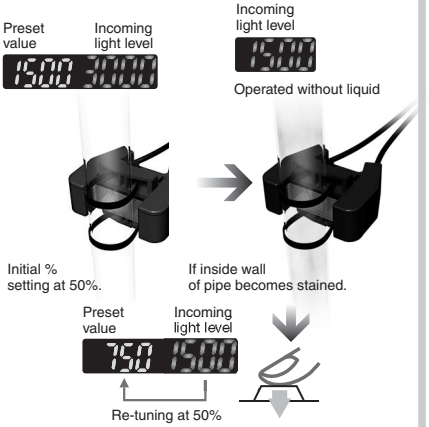
An LO signal is used for chip supply.

Detection of liquid level.....

Different time, different person –same setting!

Tuning can be done only with no liquid present.

HPF-T034 pipe-mounted fiber-optic liquid-level sensor



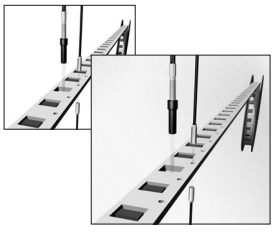
When used with incoming light level without liquid.

●Remote tuning –Seamless remote tuning– NEW

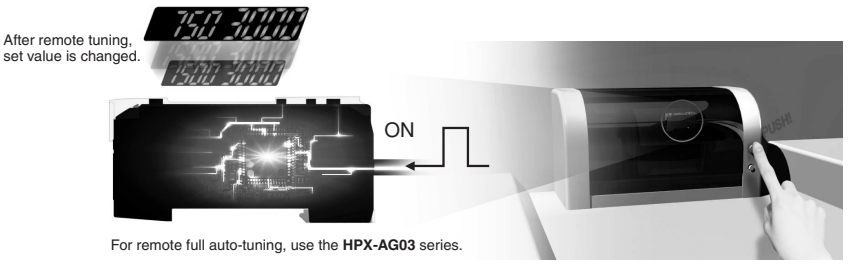
Long-term reliability

Flexibility for tooling changes

BGS or % tuning can be done remotely from a connected device. Seamless remote tuning is carried out based on the sensing situation. For the sensing type selected in advance, this function selects one of 3 types of sensitivity and the appropriate setting value. Even when the light level is dropping due to a change in tooling, application environment, or installation conditions, stable and highly accurate detection can be assured by periodic re-tuning.



Environment has worsened due to paper powder.



For remote full auto-tuning, use the **HPX-AG03** series.

Remote tuning

●Superior timer functions

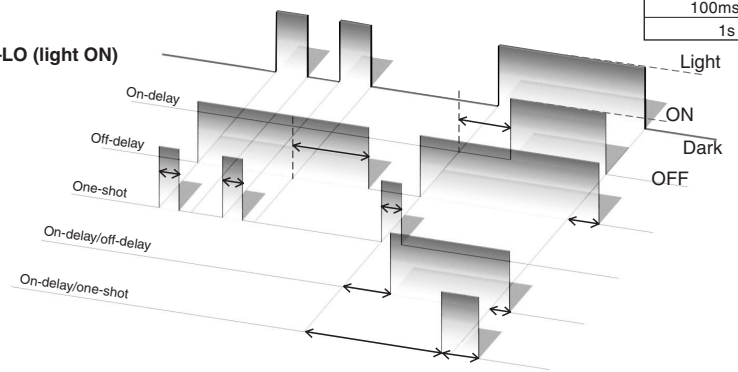
The advanced functions of the **HPX-AG**'s combination timer go beyond the standard on-delay/off-delay functions and the newer one-shot timer function.

For small-parts detection

Timer setting time

Timer setting range	Setting unit
250µs / 500µs	—
1ms to 5ms	500µs
6ms to 99ms	1ms
100ms to 900ms	100ms
1s to 90s	1s

Time chart—LO (light ON)

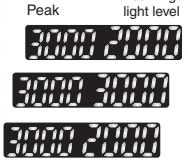


NEW

●Peak/bottom display

Since peak and incoming light levels are displayed at the same time, the light axis can be aligned precisely.

For more precise light axis alignment



Selectable peak/bottom display modes

Peak hold	&	Incoming light level
Bottom hold	&	Incoming light level
Peak hold	&	Bottom hold

Hold time can be selected from 2s, 10s, and unlimited.

●Mutual interference prevention function

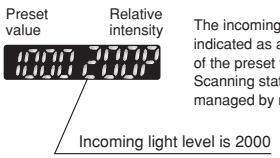
With optical communications, mutual interference between sensors can be prevented. Pack up to 8 units closely together!

Up to 8 units can be closely mounted together.

This function is available in HP, nL and SF sensing modes.

●Display type selection

Relative incoming light intensity (instead of absolute) can also be displayed with the preset value.

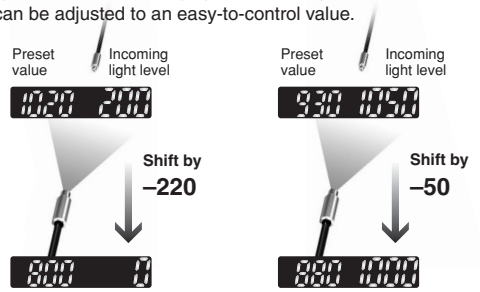


The incoming light level is indicated as a percentage of the preset value (= 100%). Scanning status can be managed by ratio.

●Displayed value shift function

For control of incoming light level

This function compensates for variation in the incoming light level. The incoming light level during operation can be adjusted to an easy-to-control value.

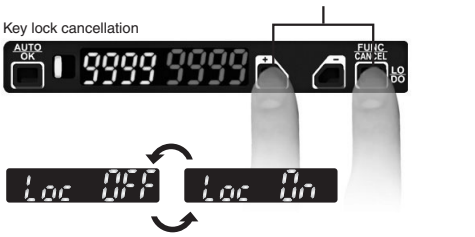


●Key lock function

Key lock can be set for all keys, or for all except tuning keys.

Accidental key-press prevention

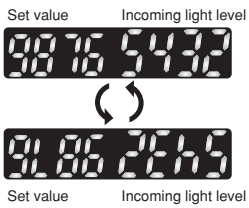
Key lock is toggled ON/OFF as shown below.



NEW

●Display inversion function

This function inverts the display, for easy reading whichever way the sensor is mounted.



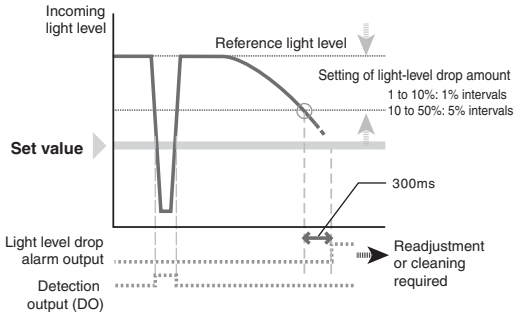
Optimum sensors for a variety of applications

●Remote tuning alarm output model **HPX-AG02** Preventive maintenance

This sensor warns if the scanning conditions are unsuitable or if the desired differential is too small for reliable detection.

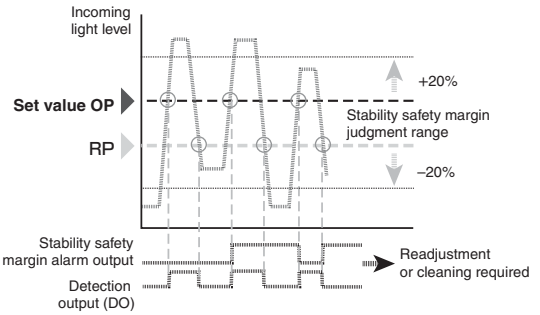
■ Light level drop alarm output

The drop level is set using the maximum light level during tuning as the reference level.



■ Stability safety margin alarm output

In case of light-ON operation when the incoming light level is 20% or less of the set value, or dark-ON operation when the level is within –20% of the set value, an alarm signal is output so that the user knows that detection is unreliable at the existing set value.



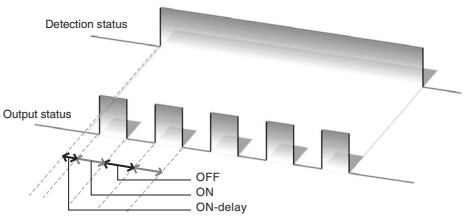
●Remote tuning error alarm **HPX-AG03**

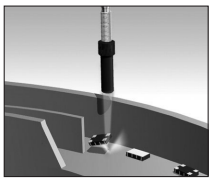
If a tuning error occurs during remote tuning, an alarm signal is output. The **HPX-AG03** allows full auto-tuning remotely.

●Advanced timer model **HPX-AG04**

■ Heartbeat — Patent Pending

ON-delay and one-shot output are repeated at regular intervals while an object is detected.



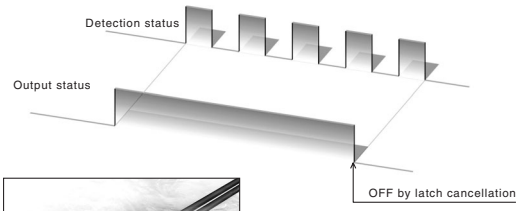


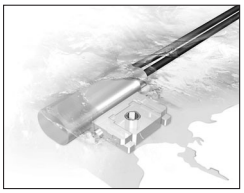
Example application: In chip sorting, an air jet is repeated at regular intervals until a rejected chip is removed.

■ Output latch — Used for interlock

When an object is detected (or is not detected), latched output is turned ON, and remains ON no matter what the detection status is.

During operation, the amplifier display blinks.

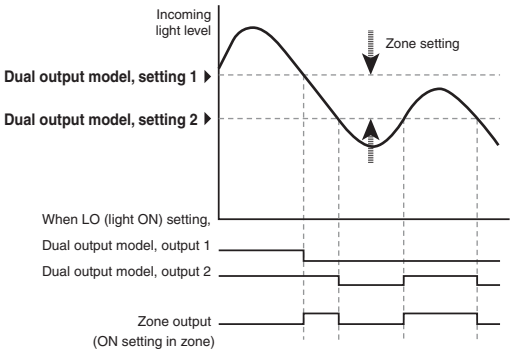




Example application:
An interlock for liquid leakage detection, used in combination with the **HPF-D040** liquid leak fiber-optic detector.

●Dual output model **(HPX-AG06)** and Active zone model **(HPX-AG07)**

These models can handle detection jobs that once required multiple units, or that were difficult with conventional setting methods.



■HPX-AG06

Because of its 2 independently set outputs, the dual output model can handle applications that formerly required 2 units. In addition, with some target objects a 3-status judgment is possible.

■HPX-AG07

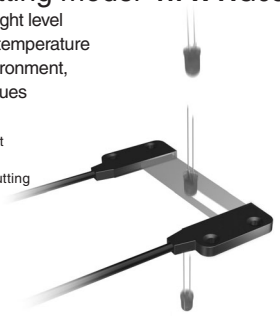
The active zone model allows the user to set a range of values rather than just one. Output turns ON within the active zone and OFF outside the zone. Reverse operation is also possible.

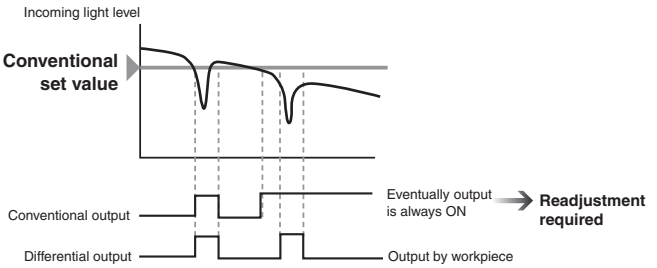
●Differential setting model **HPX-AG08**

Neutralizes effects of dirt and dimming light level

Unaffected by gradual light level change due to dust, or temperature change or ambient environment, sensor operation continues without readjustment.

Light level drop alarm output is also available.
Effective for use when outputting the sensitivity limitation.





●Data bank model **HPX-AG09**

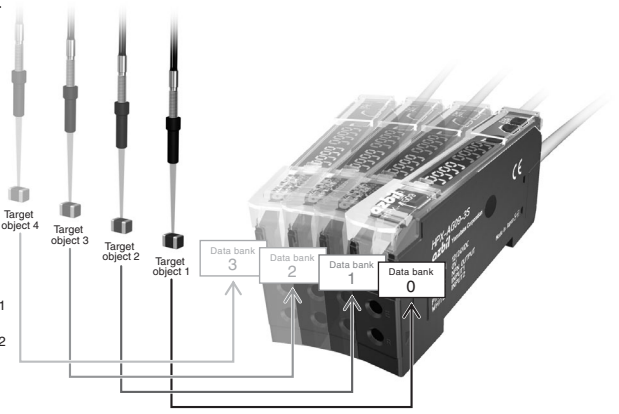
Switch between stored settings

Data bank selection can be changed by external input or manually.
Each data bank consists of a set value, LO/DO setting and timer.
Up to 8 data banks can be stored.

■Data bank selection by external changeover input

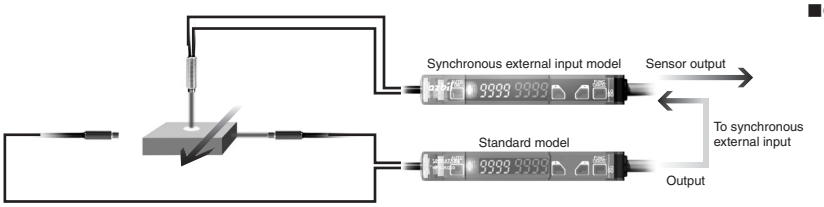
	Data bank 0	Data bank 1	Data bank 2	Data bank 3
Input 1	OFF	ON	OFF	ON
Input 2	OFF	OFF	ON	ON

Note: Data bank changeover by external input is possible for up to 4 data banks.

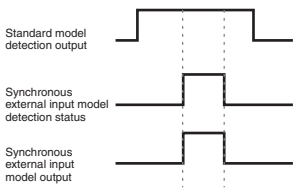


●Synchronous external input model **HPX-AG11**

This model accepts the output of another sensor or PLC and uses it together with sensing data to determine output. When the detection status satisfies the conditions for output, the external input is used to make the final determination of whether an output signal will be sent.



■Operation chart



Filter delay for external input is 100 ms.
A special model for high speed input is also available. Contact Yamatake Corporation for details.

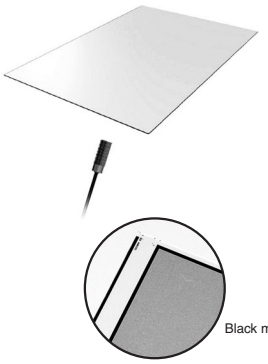
REFERENCE DATE FOR TARGET DETECTION

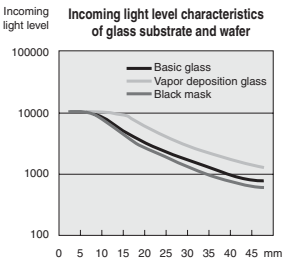
(Be sure to test using an actual target object.)

●Standard diffuse scan fiber **HPF-D002**

Glass substrate

Sensing mode: HP3

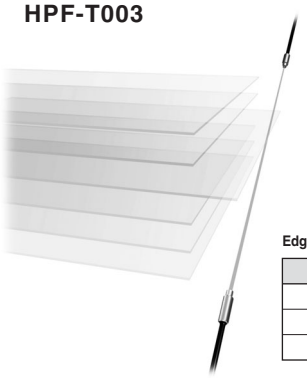




●Standard thru scan fiber unit **HPF-T003**

Glass substrate

Sensing mode: HP3



Edge detection repeatability accuracy

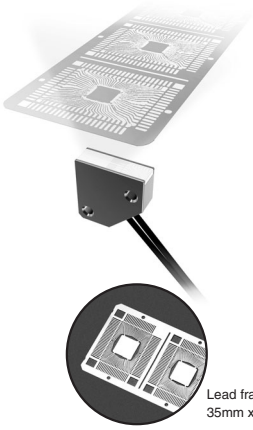
Item	Amount
σ	3μm max.
4σ	13μm max.
Max.-min.	11μm

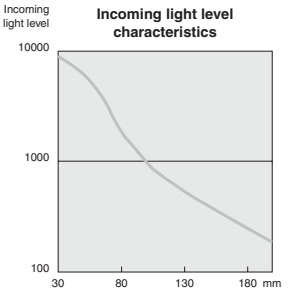
On remote tuning models, if tuning is repeated before sensing, the repetition accuracy can be further increased.

●Fiber unit with diffuse scan array **HPF-D026**

Lead frame

Sensing mode: HP3



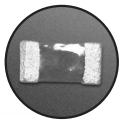


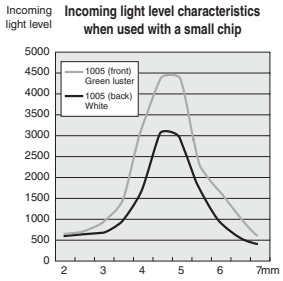
Using wide light beams, a hole in a lead frame or notch in a workpiece can be reliably detected.

●Coaxial diffuse scan fiber unit **HPF-D034 / HPF-LU07**

Small chip

Sensing mode: SF3





Be sure to use at focas point of the lens. Incoming light level changes depending on the size of the mark or spot.

●Pipe-mounted fiber-optic liquid-level **HPF-T032 / HPF-T034**

Liquid-level in pipe

Sensing mode: nL3
For 8mm dia. pipe only: nL2

Signal-to-noise ratio(SN) data by pipe diameter Liquid: water

Catalog listing	Pipe diameter	Presence of liquid	Absence of liquid	SN
TO32	6mm	9650	530	18
	8mm	5080	150	34
TO34	12mm	110	7560	69
	19mm	75	5800	77

Values for presence or absence of liquid are incoming light level values.

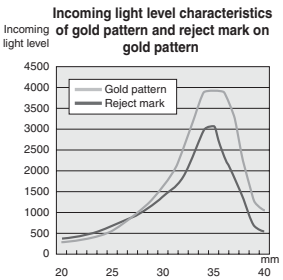
These high ratios of liquid-present to liquid-absent light levels show that detection is fully reliable.

●Coaxial diffuse scan fiber unit **HPF-D038 / HPF-LU08**

Reject mark

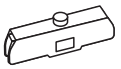
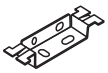
Sensing mode: FT3

The reject mark is applied to the gold pattern using an oil-based red felt pen.



Be sure to use at the lens focal point. Incoming light level changes depending on the size of mark and spot.

ATTACHMENTS (sold separately)

Name	Appearance	Features and applications	Catalog listing
End plate bracket (2 units)		This unit is a fixing plate used for DIN rail mounting. It is not included with the amplifier.	**HPX-PA03**
Dedicated mounting bracket (1 unit)		This unit is a dedicated bracket used when mounting an amplifier. It is not included with the amplifier.	**HPX-PA04**

AMPLIFIER SELECTION GUIDE

Preleaaded types

Cable lead-out type

Catalog listing		Features
NPN	PNP	
HPX-AG00-1S	**HPX-AG00-2S**	Standard
HPX-AG01-1S	**HPX-AG01-2S**	Remote tuning input
HPX-AG02-1S	**HPX-AG02-2S**	Remote tuning input Alarm (light level drop and stability safety margin) output
HPX-AG03-1S	**HPX-AG03-2S**	Remote tuning input Tuning error output

Reduced wiring type

Table1

Catalog listing		Type	Features
NPN	PNP		
HPX-AG00-3S	**HPX-AG00-4S**	Main unit	Standard
HPX-AG00-5S	**HPX-AG00-6S**	Expansion unit	
HPX-AG01-3S	**HPX-AG01-4S**	Main unit	Remote tuning input
HPX-AG01-5S	**HPX-AG01-6S**	Expansion unit	
HPX-AG09-3S	**HPX-AG09-4S**	Main unit	Data bank setting, changeover input

Standard cable length is 2m. Catalog listings for 1m or 5m cable models have the suffix **-L01** or **-L05** respectively.

Table2

Catalog listing	Type	Features
NPN		
HPX-AG04-3S	Main unit	Advanced function timer (latch and heartbeat) function, latch cancellation input
HPX-AG04-5S	Expansion unit	
HPX-AG06-3S	Main unit	Dual output, dual set values
HPX-AG06-5S	Expansion unit	
HPX-AG07-3S	Main unit	Active zone setting
HPX-AG07-5S	Expansion unit	
HPX-AG08-3S	Main unit	Differential setting, alarm output
HPX-AG08-5S	Expansion unit	
HPX-AG11-3S	Main unit	Synchronous external input
HPX-AG11-5S	Expansion unit	

M8 connector types

Table1

Catalog listing		Features
NPN	PNP	
HPX-AG00-1S-CT	**HPX-AG00-2S-CT**	Standard

Table2

Catalog listing	Features
PNP	
HPX-AG06-2S-CT	Dual output, dual set values
HPX-AG07-2S-CT	Active zone setting

Quick Function Reference Table

	DI	DO	Remote tuning input	Full auto-tuning	Remote full auto-tuning	Remote tuning input tuning error output	Light level drop alarm output	Stability safety margin alarm output	APC output	Output latch and cancellation input	Heartbeat
AG00: Standard	0	1	–	○	–	–	–	–	–	–	–
AG01: Remote tuning input	1	1	○	–	–	–	–	–	–	–	–
AG02: Remote tuning input Alarm output	1	2	○	–	–	–	○	○	○	–	–
AG03: Remote tuning input Tuning error output	1	2	○	○	○	○	–	–	–	–	–
AG04: Advanced function timer function	1	1	–	○	–	–	–	–	–	○	○
AG06: Dual output, dual set values	0	2	–	○	–	–	–	–	–	–	○
AG07: Active zone setting	0	1	–	–	–	–	–	–	–	–	○
AG08: Differential setting	0	2	–	–	–	–	○	–	–	–	–
AG09: Data bank setting, changeover input	2	1	–	○	–	–	–	–	–	–	○
AG11: Synchronous external input	1	1	–	○	–	–	–	–	–	–	○

Note regarding APC output: Output is produced when the auto power control function can no longer compensate for LED aging, indicating the need to replace the LED.

AMPLIFIER SPECIFICATIONS

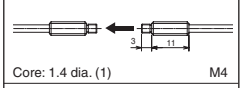
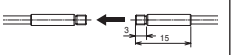
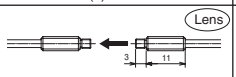
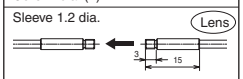
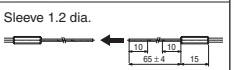
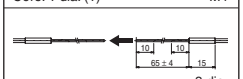
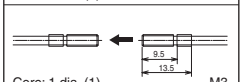
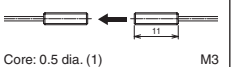
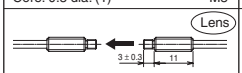
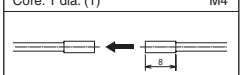
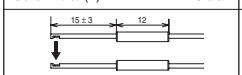
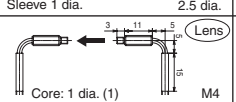
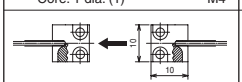
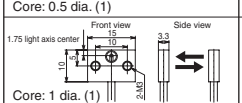
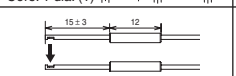
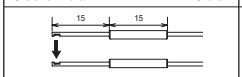
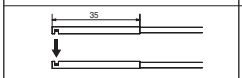
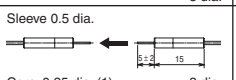
Catalog listing	**NPN**	**HPX-AG00-1S(-CT) HPX-AG00-3S HPX-AG00-5S**	**HPX-AG01-1S HPX-AG01-3S HPX-AG01-5S**	**HPX-AG02-1S HPX-AG03-1S HPX-AG04-3S HPX-AG04-5S**	**HPX-AG06-3S HPX-AG06-5S HPX-AG07-3S HPX-AG07-5S**	**HPX-AG08-3S HPX-AG08-5S HPX-AG09-3S HPX-AG11-3S HPX-AG11-5S**
	PNP	**HPX-AG00-2S(-CT) HPX-AG00-4S HPX-AG00-6S**	**HPX-AG01-2S HPX-AG01-4S HPX-AG01-6S**	**HPX-AG02-2S HPX-AG03-2S**	**HPX-AG06-2S-CT HPX-AG07-2S-CT**	**HPX-AG09-4S**
Addition	**Output**	**—**	**—**	**02-□S: alarm output 03-□S: error output**	**06-□S: control output**	**08-□S: alarm output**
	Input	**—**	**Remote tuning**	**02-□S: remote tuning 03-□S: remote tuning 04-□S: latch cancellation**	**—**	**09-3S : changeover 2-input 11-□S : synchronous input**

Supply voltage		12 to 24Vdc ±10% (ripple 10% max.)
Current consumption		750mW max. (at 24V power supply and 30mA current consumption), monitor sleep mode 500mW max.
Hysteresis		20% max. (at rated scanning distance)
Operation mode		Light-ON / Dark-ON changeable (setting by changeover switch)
Control output		**-1S/-3S/-5S**: NPN transistor open collector. **-2S/-4S/-6S**: PNP transistor open collector. Cable lead-out type (single output) : switching current 100mA max. (resistive load), output voltage 26.4V, voltage drop 2V max. (switching current 100mA). Cable lead-out type (dual output) : switching current 50mA max. (resistive load), output voltage 26.4V, voltage drop 2V max. (switching current 50mA). Reduced wiring type (single output) : switching current 50mA max. (resistive load), output voltage 26.4V, voltage drop 2V max. (switching current 30mA). Reduced wiring type (dual output) : switching current 30mA max. (resistive load), output voltage 26.4V, voltage drop 2V max. (switching current 30mA).
External input		When ON (short-circuit current is approx. 1mA): DC 0–1V. When OFF: open or connection to + side of power supply
Response time		50μs (High Speed) , 250μs (Fast) , 500μs (Semi-Fast) , 1ms (Normal) and 5ms (High Power)
Timer function	**Type**	Timer OFF, ON delay, OFF delay, one shot, ON-delay + one shot , and ON delay + OFF delay. **04-□S**: ON heartbeat , OFF heartbeat, ON delay + heartbeat, and OFF delay + heartbeat. Positive edge latch, negative edge latch, ON delay + positive edge latch, and ON delay + negative edge latch.
	Preset value	250μs, 500μs and 1ms to 5ms: 1ms unit, 500μs unit and 6 to 99ms: 1ms unit, 100ms to 900ms: 100ms unit, and 1s to 90s: 1s unit. Heartbeat only: 1ms to 5ms: 1ms unit, 500μs unit and 6 to 99ms: 1ms unit, 100ms to 900ms: 100ms unit, and 1s to 90s: 1s unit.
Light emitter		Red LED
Display function		Output indicator: orange. Preset value: green 4-digit LED. Incoming light level: red 4-digit LED. Preset value + incoming light level / preset value + relative value / peak + incoming / bottom + incoming / peak + bottom.
Reduced wiring type addition		Up to 15 expansion units can be connected.
Ambient light immunity		Incandescent light: 5,000 lux max. Sunlight: 20,000 lux max.
Operating temperature		–20 to +55˚C*
Storage temperature		–40 to +70˚C
Operating humidity		35 to 85% (no condensation allowed)
Vibration resistance		10 to 55Hz, 1.5mm peak-to-peak amplitude, 2 hours each in X, Y and Z directions
Shock resistance		500m/s^2, 3 times each in X, Y and Z directions
Weight		**HPX-AG□□-1S/-2S/-3S/-4S**: approx. 75g, **-5S/-6S**: approx. 40g (body only with 2m cable)
Circuit protection		Power supply reverse connection protection circuit, malfunction prevention circuit at power ON (approx. 200ms), output short-circuit protection circuit

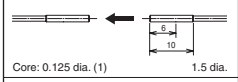
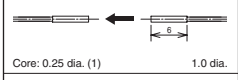
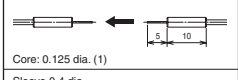
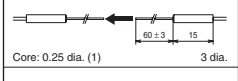
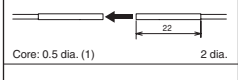
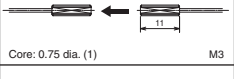
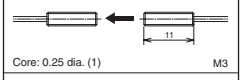
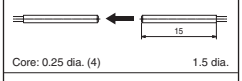
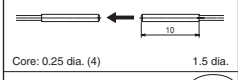
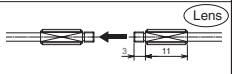
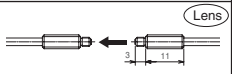
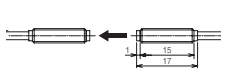
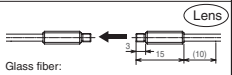
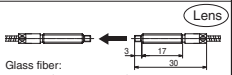
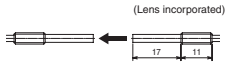
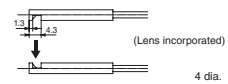
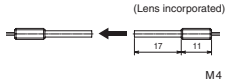
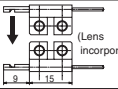
* Operating temperature is different depending on the number of gang-mounted sensor units. 1 or 2 units: –20 to +55˚C, 3 units: –20 to +50˚C, 4 or 5 units: –20 to +45˚C, 6 units: –20 to +40˚C
The **HPX-AG06** (2-setting and 2-output model) and **HPX-AG07** (zone setting model) do not have Fast or High Speed response time (sensing type) settings. After Semi Fast, the next fastest speed is Semi High Speed (140μs). For the response time of the **HPX-AG08** (differential setting model), please contact Yamatake Corporation.

FIBER UNIT AND SENSING TYPE COMBINATIONS

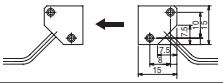
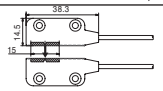
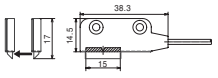
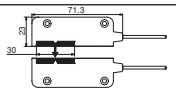
Thru scan

Group	Appearance	Sensing type	Scanning distance (mm)	Features	Cable length (cuttable)	Bend radius	Catalog listing
Long distance	 Core: 1.4 dia. (1) M4	HP3 nL3 SF3 FT3 HS3	2,230 1,450 1,160 635 360	Long scanning distance	Free cut 2m	R20	HPF-T001
	 Core: 1.4 dia. (1) 3 dia.						HPF-T002
Standard	 Core: 1 dia. (1) M4			Standard		R20	HPF-T003
	 Core: 1 dia. (1) 3 dia.						HPF-T004
	 Core: 1 dia. (1) M4	HP3 nL3 SF3 FT3 HS3	1,200 800 640 350 200	Sleeve (flexible)	Free cut 2m	R10/R20	HPF-T005
	 Core: 1 dia. (1) 3 dia.						HPF-T006
	 Core: 1 dia. (1) M3			Standard diameter and compact		R20	HPF-T045
Ultra bend - tolerant	 Core: 0.5 dia. (1) M3	HP3 nL3 SF3 FT3 HS3	140 95 75 42 24	Static installation, flexible, and small diameter	Free cut 2m	R1	HPF-T024
	 Core: 1 dia. (1) M4	HP3 nL3 SF3 FT3 HS3	865 600 470 260 150	Static installation, flexible, and standard model		R2	HPF-T025
	 Core: 1 dia. (1) 3 dia.						HPF-T031
	Sleeve 1 dia. 2.5 dia.	HP3 nL3 SF3 FT3 HS3	55 35 28 15 8	Static installation, flexible, and side view model		R1	HPF-T026
Space saving	 Core: 1 dia. (1) M4	HP3 nL3 SF3 FT3 HS3	865 570 450 250 140	Elbow	Free cut 2m	R20	HPF-T010
	 Core: 0.5 dia. (1)	HP3 nL3 SF3 FT3 HS3	140 95 75 42 24	Static installation, flexible, small diameter, and flat top view model		R1	HPF-T028
	 Core: 1 dia. (1)	HP3 nL3 SF3 FT3 HS3	210 140 110 60 35	Static installation, flexible, standard, and flat side view model		R5	HPF-T028LF
Side view	 Sleeve 1 dia. 2.5 dia.	HP3 nL3 SF3 FT3 HS3	145 110 90 48 28	Small diameter sleeve	Free cut 2m	R15	HPF-T007
	 Sleeve 0.88 dia. 2.5 dia.	HP3 nL3 SF3 FT3 HS3	55 35 28 15 8	Fine diameter sleeve	Free cut 1m	R5	HPF-T037
	 3 dia.	HP3 nL3 SF3 FT3 HS3	660 440 350 190 110	Standard diameter	Free cut 2m	R20	HPF-T042
Small diameter	 Core: 0.25 dia. (1) 3 dia.	HP3 nL3 SF3 FT3 HS3	34 25 20 11 7	Fine diameter	Free cut 2m	R15	HPF-T015

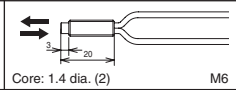
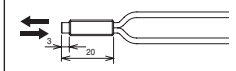
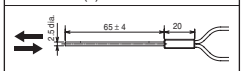
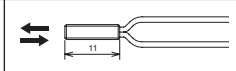
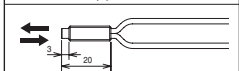
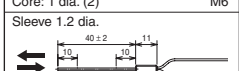
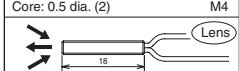
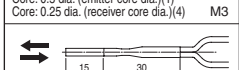
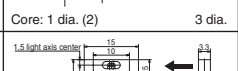
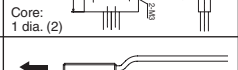
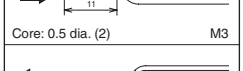
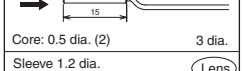
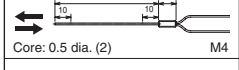
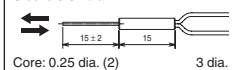
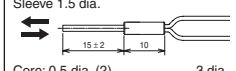
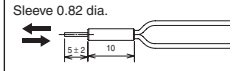
For the **HPX-AG06** (dual output, dual set values) and **HPX-AG07** (active zone setting), the FT3 and HS3 sensing modes (for response speed) are not available. The sensing mode faster than SF3 is SH3, with approx. 35% of the sensing distance of nL3. For the response time of the **HPX-AG08** (differential setting model), please contact Yamatake Corporation.

Group	Appearance	Sensing type	Scanning distance (mm)	Features	Cable length (cuttable)	Bend radius	Catalog listing
Small diameter	 Core: 0.125 dia. (1) 1.5 dia.	HP3 nL3 SF3 FT3 HS3	17 12 10 5 3	Fine diameter	Connector 0.5m	R15	HPF-T036
	 Core: 0.25 dia. (1) 1.0 dia.	HP3 nL3 SF3 FT3 HS3	34 25 20 11 7				HPF-T038
	Sleeve 0.4 dia.  Core: 0.125 dia. (1)	HP3 nL3 SF3 FT3 HS3	17 12 10 5 3	Fine diameter sleeve			HPF-T039
	Sleeve 0.4 dia.  Core: 0.25 dia. (1) 3 dia.	HP3 nL3 SF3 FT3 HS3	35 20 18 10 8	Fine diameter sleeve	Free cut 2m		HPF-T040
	 Core: 0.5 dia. (1) 2 dia.	HP3 nL3 SF3 FT3 H3	300 200 160 90 45	Small diameter			HPF-T043
	 Core: 0.75 dia. (1) M3	HP3 nL3 SF3 FT3 HS3	675 450 360 195 110	Small diameter and long scanning distance			HPF-T044
Elastic	 Core: 0.25 dia. (1) M3						HPF-T008
	 Core: 0.25 dia. (4) 1.5 dia.	HP3 nL3 SF3 FT3 HS3	180 120 100 50 30	Elastic small diameter	Free cut 2m	R4	HPF-T046
	 Core: 0.25 dia. (4) 1.5 dia.						HPF-T009
	Lens  Core: 0.25 dia. (16) M4	HP3 nL3 SF3 FT3 HS3	940 650 520 280 160	Elastic standard diameter			HPF-T033
Heat resistant	Lens  Core: 1 dia. (1) M4	HP3 nL3 SF3 FT3 HS3	700 460 365 200 115	To 105˚C	Free cut 2m	R25	HPF-T012
	 Core: 1.5 dia. (1) M4	HP3 nL3 SF3 FT3 HS3	1200 800 640 350 200	To 150˚C		R35	HPF-T017
	Lens  Glass fiber: 1 dia. (0.05 dia. x 320) (1) M4	HP3 nL3 SF3 FT3 HS3	620 410 325 180 100	To 200˚C	Connector 1m	R15	HPF-T018
	Lens  Glass fiber: 0.05 dia. (0.05 dia. x 370) M4	HP3 nL3 SF3 FT3 HS3	660 440 355 190 110	Heat and cold resistant from -60˚C to +350˚C	Connector 2m	R25	HPF-T014
Narrow beam	(Lens incorporated)  M4	HP3 nL3 SF3 FT3 HS3	4,140 2,760 2,200 1,200 680	Parallel beam top view	Free cut 2m	R20	HPF-T019
	 (Lens incorporated) 4 dia.	HP3 nL3 SF3 FT3 HS3	4,500 3,000 2,390 1,300 750	Parallel beam side view			HPF-T020
	(Lens incorporated)  M4	HP3 nL3 SF3 FT3 HS3	3,600 2,400 1,920 1,050 600	Narrow beam top view		R15	HPF-T023
Mapping	Core: 1.5 dia. (1)  (Lens incorporated)	HP3 nL3 SF3 FT3 HS3	500 500 500 450 130	Narrow beam -1.5˚/+1.5˚max. side view	Free cut 2m	R5	HPF-T030

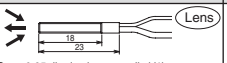
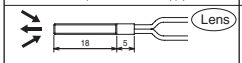
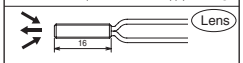
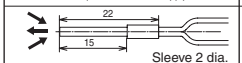
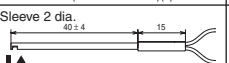
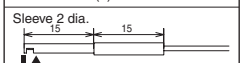
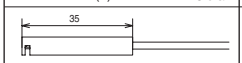
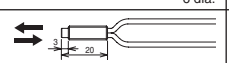
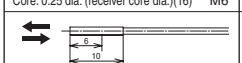
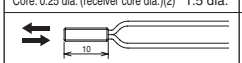
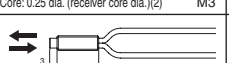
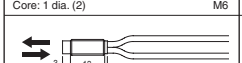
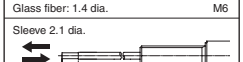
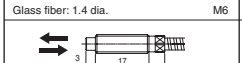
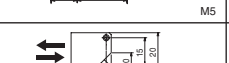
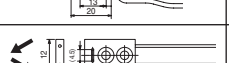
For the **HPX-AG06** (dual output, dual set values) and **HPX-AG07** (active zone setting), the FT3 and HS3 sensing modes (for response speed) are not available. The sensing mode faster than SF3 is SH3, with approx. 35% of the sensing distance of nL3. For the response time of the **HPX-AG08** (differential setting model), please contact Yamatake Corporation.

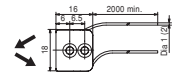
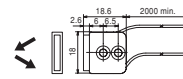
Group	Appearance	Sensing type	Scanning distance (mm)	Features	Cable length (cuttable)	Bend radius	Catalog listing
Wide beam		HP3 nL3 SF3 FT3 HS3	790 520 415 230 130	Array	Free cut 2m	R4	HPF-T021
		HP3 nL3 SF3 FT3 HS3	3,600 2,400 1,900 1,000 580	Beam 15mm wide		R15	HPF-T021T
		HP3 nL3 SF3 FT3 HS3	3,450 2,300 1,800 950 500	Beam 15mm wide Side beam			HPF-T021S
		HP3 nL3 SF3 FT3 HS3	3,600 3,600 3,200 1,700 1000	Beam 30mm wide			HPF-T021WT

Diffuse scan

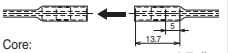
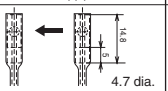
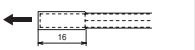
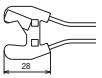
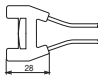
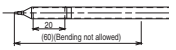
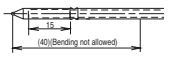
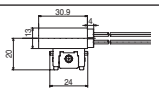
Group	Appearance	Sensing type	Scanning distance (mm)	Features	Cable length (cuttable)	Bend radius	Catalog listing
Long distance	 Core: 1.4 dia. (2) M6	HP3 nL3 SF3 FT3 HS3	580 400 285 175 80	Long scanning distance	Free cut 2m	R20	HPF-D001
Standard	 Core: 1 dia. (2) M6	HP3 nL3 SF3 FT3 HS3	430 300 215 130 80	Standard	Free cut 2m	R20	HPF-D002
	 Core: 1 dia. (2) M6						HPF-D003
Ultra bend - tolerant	 Core: 0.5 dia. (2) M3	HP3 nL3 SF3 FT3 HS3	25 19 15 8 3	Small diameter	Free cut 2m	R1	HPF-D029
	 Core: 1 dia. (2) M6	HP3 nL3 SF3 FT3 HS3	230 160 115 70 30	Standard		R2	HPF-D030
	Sleeve 1.2 dia.  Core: 0.5 dia. (2) M4	HP3 nL3 SF3 FT3 HS3	25 19 15 8 3	Small diameter sleeve (bendable)		R10/R1	HPF-D031
	Lens  Core: 0.5 dia. (emitter core dia.)(1) Core: 0.25 dia. (receiver core dia.)(4) M3	HP3 nL3 SF3 FT3 HS3	50 35 25 14 7	Coaxial		R1/R4	HPF-D032
	 Core: 1 dia. (2) 3 dia.	HP3 nL3 SF3 FT3 HS3	240 160 130 70 40	Standard diameter		R5	HPF-D044
Compact	 Core: 1 dia. (2)	HP3 nL3 SF3 FT3 HS3	105 70 55 30 15	Static installation, flexible, standard, and flat side-view model	Free cut 2m	R2	HPF-D045LF
Small diameter	 Core: 0.5 dia. (2) M3			Small diameter	Free cut 2m	R15	HPF-D004
	 Core: 0.5 dia. (2) 3 dia.	HP3 nL3 SF3 FT3 HS3	110 80 60 35 15				HPF-D005
	Sleeve 1.2 dia. Lens  Core: 0.5 dia. (2) M4			Small diameter sleeve			HPF-D006
	 Core: 0.75 dia. (2) M4	HP3 nL3 SF3 FT3 HS3	215 150 110 65 30	Small diameter long scanning distance			HPF-D018
	Sleeve 0.82 dia. Core: 0.25 dia. (2) 3 dia.	HP3 nL3 SF3 FT3 HS3	11 8 6 4 2	Fine diameter sleeve	Free cut 0.5m		HPF-D019
	Sleeve 1.5 dia.  Core: 0.5 dia. (2) 3 dia.	HP3 nL3 SF3 FT3 HS3	95 65 45 28 13	Small diameter sleeve	Free cut 2m		HPF-D021
	Sleeve 0.82 dia.  Core: 0.25 dia. (2) 2.5 dia.	HP3 nL3 SF3 FT3 HS3	11 8 6 4 2	Fine diameter sleeve	Free cut 0.5m	R4	HPF-D039
Coaxial	 Core: 1 dia. (emitter core dia.)(1) Core: 0.25 dia. (receiver core dia.)(16) M6	HP3 nL3 SF3 FT3 HS3	430 300 215 130 60	Coaxial	Free cut 2m	R20	HPF-D009
	Lens Core: 0.5 dia. (emitter core dia.)(1) Core: 0.25 dia. (receiver core dia.)(4) M3	HP3 nL3 SF3 FT3 HS3	95 65 45 28 13			R15	HPF-D010

For the **HPX-AG06** (dual output, dual set values) and **HPX-AG07** (active zone setting), the FT3 and HS3 sensing modes (for response speed) are not available. The sensing mode faster than SF3 is SH3, with approx. 35% of the sensing distance of nL3. For the response time of the **HPX-AG08** (differential setting model), please contact Yamatake Corporation.

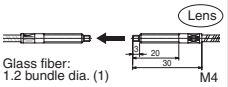
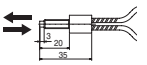
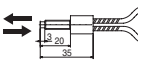
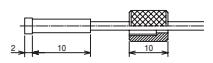
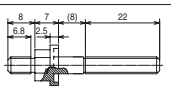
Group	Appearance	Sensing type	Scanning distance (mm)	Features	Cable length (cuttable)	Bend radius	Catalog listing
Coaxial	 Core: 0.25 dia. (emitter core dia.)(1) Core: 0.25 dia. (receiver core dia.)(6) M3	HP3 nL3 SF3 FT3 HS3	70 45 30 20 8	Coaxial	Connector 0.5m	R4	HPF-D034
	 Core: 0.5 dia. (emitter core dia.)(1) Core: 0.25 dia. (receiver core dia.)(9) M3	HP3 nL3 SF3 FT3 HS3	95 95 70 40 20		Free cut 2m	R15	HPF-D035
	 Core: 0.5 dia. (emitter core dia.)(1) Core: 0.25 dia. (receiver core dia.)(9) M4						HPF-D038
	Core: 0.5 dia. (emitter core dia.)(1) Core: 0.25 dia. (receiver core dia.)(9) 3 dia.	HP3 nL3 SF3 FT3 HS3	100 65 50 30 15	Small diameter coaxial			HPF-D042
Side view	Sleeve 2 dia. Core: 0.5 dia. (2) 3 dia.	HP3 nL3 SF3 FT3 HS3	45 30 20 13 7	Small diameter sleeve	Free cut 2m	R15	HPF-D011
	Sleeve 2 dia.  Core: 0.5 dia. (2) 2.8 dia.			Small diameter short sleeve			HPF-D041
	 6 dia.	HP3 nL3 SF3 FT3 HS3	180 120 95 50 30	Standard diameter		R20	HPF-D043
Elastic	 Core: 0.25 dia. (emitter core dia.)(16) Core: 0.25 dia. (receiver core dia.)(16) M6	HP3 nL3 SF3 FT3 HS3	265 190 140 80 40	Standard	Free cut 2m	R4	HPF-D012
	 Core: 0.25 dia. (emitter core dia.)(2) Core: 0.25 dia. (receiver core dia.)(2) 1.5 dia.	HP3 nL3 SF3 FT3 HS3	17 15 11 7 3	Small diameter sleeve	Connector 1m		HPF-D036
	 Core: 0.25 dia. (emitter core dia.)(2) Core: 0.25 dia. (receiver core dia.)(2) M3	HP3 nL3 SF3 FT3 HS3	21 15 11 7 3	Small diameter	Free cut 2m		HPF-D037
Heat resistant	 Core: 1 dia. (2) M6	HP3 nL3 SF3 FT3 HS3	190 190 140 80 40	To 105˚C	Free cut 2m	R25	HPF-D013
	 Core: 1.5 dia. (2) M6	HP3 nL3 SF3 FT3 HS3	430 300 215 130 60	To 150˚C		R35	HPF-D022
	Glass fiber: 1.4 dia. M6	HP3 nL3 SF3 FT3 HS3	190 130 95 60 25	To 200˚C	Free cut 1m	R15	HPF-D023
	Sleeve 2.1 dia. Glass fiber: 1.4 dia. M6			Sleeve heat resistant to 200˚C			HPF-D024
	 Glass fiber: 1.5 dia. M6	HP3 nL3 SF3 FT3 HS3	160 160 120 70 30	Heat and cold resistant from -60˚C to 350˚C	Connector 2m	R25	HPF-D015
Parallel beam	(Built-in lens) M5	HP3 nL3 SF3 FT3 HS3	20 20 20 20 20	Parallel beam reflection	Free cut 2m	R15	HPF-D025
Wide beam		HP3 nL3 SF3 FT3 HS3	290 200 150 90 40	Array	Free cut 2m	R4	HPF-D026
Limited reflection		HP3 nL3 SF3 FT3 HS3	2.5 ± 0.5 2.5 ± 0.5 2.5 ± 0.5 2.5 ± 0.5	Limited reflection	Free cut 2m	R15	HPF-D028

Group	Appearance	Sensing type	Scanning distance (mm)	Features	Cable length (cuttable)	Bend radius	Catalog listing
Limited reflection		HP3 nL3 SF3 FT3 HS3	7.4±1.8 7.4±1.8 7.4±1.8	Limited reflection	Free cut 2m	R15	HPF-D028T
		HP3 nL3 SF3 FT3 HS3	5.2±2.0 5.2±2.0 5.2±2.0				HPF-D028F

Wet process

Group	Appearance	Sensing type	Scanning distance (mm)	Features	Cable length (cuttable)	Bend radius	Catalog listing
Oil and chemical-proof	(Built-in lens)  Core: 3 dia. (effective lens dia.)(1) 4.7 dia.	HP3 nL3 SF3 FT3 HS3	4,500 3,000 2,160 1,300 580	PFA tube small diameter	Free cut 2m	R20	HPF-T029
	 4.7 dia.	HP3 nL3 SF3 FT3 HS3	1,030 690 490 300 140				HPF-T035
	 Core: 1 dia. (2) 6 dia.	HP3 nL3 SF3 FT3 HS3	190 130 95 60 25	PFA tube		R20/R80	HPF-D014
Liquid level		—	—	Pipe-mounted. Light received when liquid present. 3 to 13mm dia. pipes.	Free cut 5m	R4	HPF-T032
		—	—	Pipe-mounted. Light received when liquid absent. 8 to 19mm dia. pipes.			HPF-T034
	 6 dia.	—	—	Contact type. PFA tube 6mm dia.	Free cut 2m	R25/R40	HPF-D027
	 4 dia.	—	—	Contact type. PFA tube 4mm dia.		R15/R30	HPF-D033
Liquid leak		—	—	Contact type	Free cut 5m	R20	HPF-D040

Vacuum

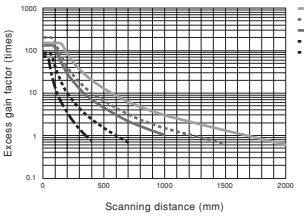
Group	Appearance	Sensing type	Scanning distance (mm)	Features	Cable length (cuttable)	Bend radius	Catalog listing
Thru scan	 Glass fiber: 1.2 bundle dia. (1) M4	HP3 nL3 SF3 FT3 HS3	360 240 170 105 50	Heat resistant to 350˚C. Elbow connection	Connector 1m	R25	HPF-VT07
Diffuse scan	 Glass fiber: 1.7 bundle dia. M6	HP3 nL3 SF3 FT3 HS3	35 35 35 15				HPF-VD07
	 Glass fiber: 1.7 bundle dia. M6			Heat resistant to 350˚C. Straight connection			HPF-VD09
—	 Core: 1 dia.	—	—	Air side (2 units)	Free cut 2m	R20	HPF-VA01
		—	—	Heat resistant to 200˚C. Light connector (2 units)	—	—	HPF-VJ03

For the **HPX-AG06** (dual output, dual set values) and **HPX-AG07** (active zone setting), the FT3 and HS3 sensing modes (for response speed) are not available. The sensing mode faster than SF3 is SH3, with approx. 35% of the sensing distance of nL3. For the response time of the **HPX-AG08** (differential setting model), please contact Yamatake Corporation.

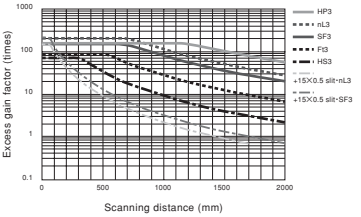
CHARACTERISTICS DIAGRAMS (typical examples)

Excess gain

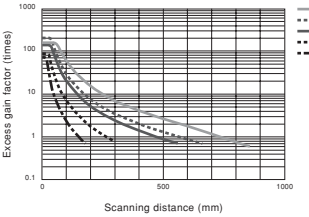
HPF-T003



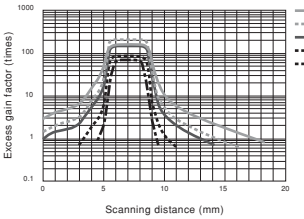
HPF-T021T



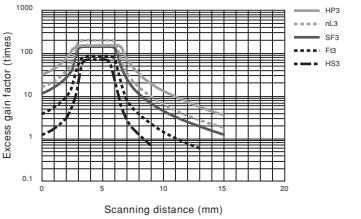
HPF-D002



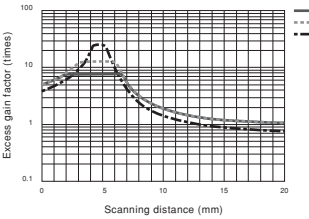
HPF-D028T



HPF-D028F

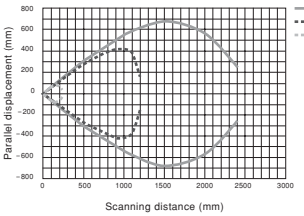


HPF-D034+Micro-spot lens unit (**HPF-LU07**)

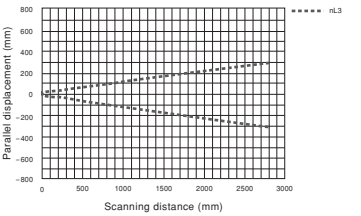


Parallel displacement

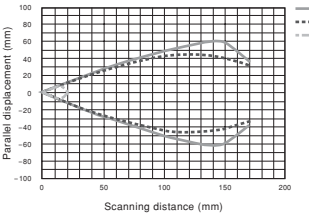
HPF-T003



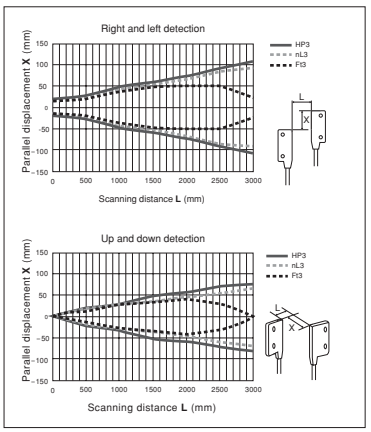
HPF-T003+Long-distance lens unit (**FE-PA-L1**)



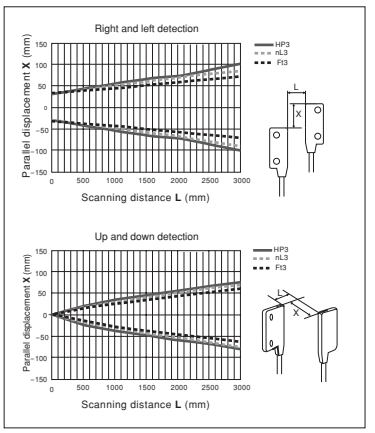
HPF-T015



HPF-T021T

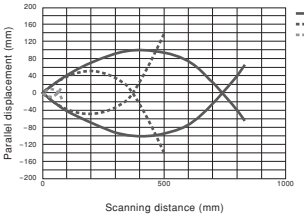


HPF-T021WT

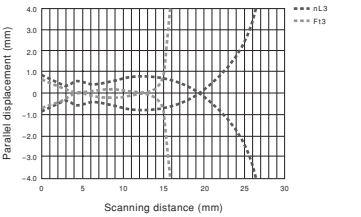


Detection area characteristics

HPF-D002



HPF-D034+Micro-spot lens unit (**HPF-LU07**)



SCANNING DISTANCE WHEN USED WITH ATTACHMENT

Attachment	**FE-PA-L1** long-distance lens unit				
Fiber unit / Sensing mode	**HPF-T003/T004**	**HPF-T010**	**HPF-T012**	**HPF-T014**	**HPF-T018**
High Power／5ms	8,400mm	6,000mm	3,000mm	4,500mm	4,300mm
Normal／1ms	4,800mm	3,400mm	1,850mm	2,600mm	2,480mm

Attachment	**FE-PA-S1** or **HPF-VL05** side view lens unit				
Fiber unit / Sensing mode	**HPF-T003/T004**	**HPF-T012**	**HPF-T014**	**HPF-T018**	**HPF-VT07**
High Power／5ms	1,400mm	670mm	570mm	550mm	420mm
Normal／1ms	800mm	370mm	330mm	310mm	240mm

Attachment	**HPF-VL06** ultra long distance lens unit				
Fiber unit / Sensing mode	**HPF-T003/T004**	**HPF-T012**	**HPF-T014**	**HPF-T018**	**HPF-VT07**
High Power／5ms	14m	5m	7.7m	7.2m	4.2m
Normal／1ms	8m	3.1m	4.4m	4.2m	2.4m

Notes : 1. Values indicate capability. Actual scanning distance is limited by fiber length (standard 2m x 2 ≒4m).
2. The data for combinations with the **HPF-VT07** assumes that it is used with the **HPF-VJ03** light connector and the **HPF-VA01** fiber unit for air.

CHARACTERISTICS OF COAXIAL DIFFUSE SCAN FIBER UNIT AND LENS ATTACHMENT (spot diameter) COMBINATIONS

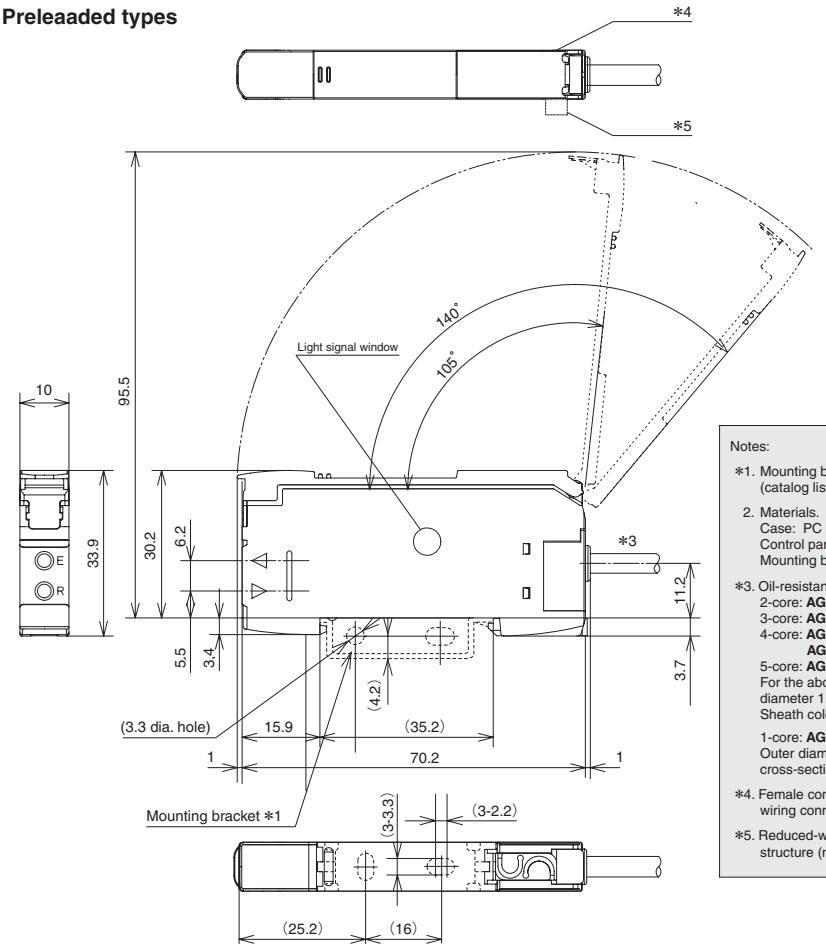
Fiber unit catalog listing	Lens catalog listing	Scanning distance / spot diameter	High Power	Normal	SF	FT	High Speed
HPF-D034	**HPF-LU07**	4.6mm / approx. 0.1mm	✓	✓	✓	✓	✓
HPF-D010		4.6mm → approx. 0.2mm	✓	✓	✓	✓	✓
HPF-D032			✓	✓	✓	✓	✓
HPF-D035			✓	✓	✓	✓	✓
HPF-D034	**HPF-LU01**	7mm → approx. 0.2mm	✓	✓	✓	✓	✓
HPF-D010		7mm → approx. 0.4mm	✓	✓	✓	✓	✓
HPF-D032			✓	✓	✓	✓	✓
HPF-D035			✓	✓	✓	✓	✓
HPF-D010	**HPF-LU02**	19mm → approx. 0.2mm	✓	✓	✓	✓	*
HPF-D032			✓	✓	✓	*	*
HPF-D035			✓	✓	✓	✓	✓
HPF-D034		19mm → approx. 1mm	✓	✓	✓	✓	*
HPF-D038	**HPF-LU08**	33mm → approx. 1mm	✓	✓	✓	✓	*
HPF-D025	—	Depends on amplifier used.	✓	✓	✓	✓	✓

Notes : 1. The **HPF-D025** is not combined with a lens.
2. This data is based on a standard target (white paper). For individual applications, check detection under actual operating circumstances.
3. ✓: Applicable. *: Detection may be possible, depending on the target.

EXTERNAL DIMENSIONS

(unit: mm)

Preleaaded types



Notes:

∗1. Mounting bracket sold separately (catalog listing: **HPX-PA04**).

2. Materials.
Case: PC resin, black
Control panel cover: PC resin, gray transparent
Mounting bracket: Stainless steel plate

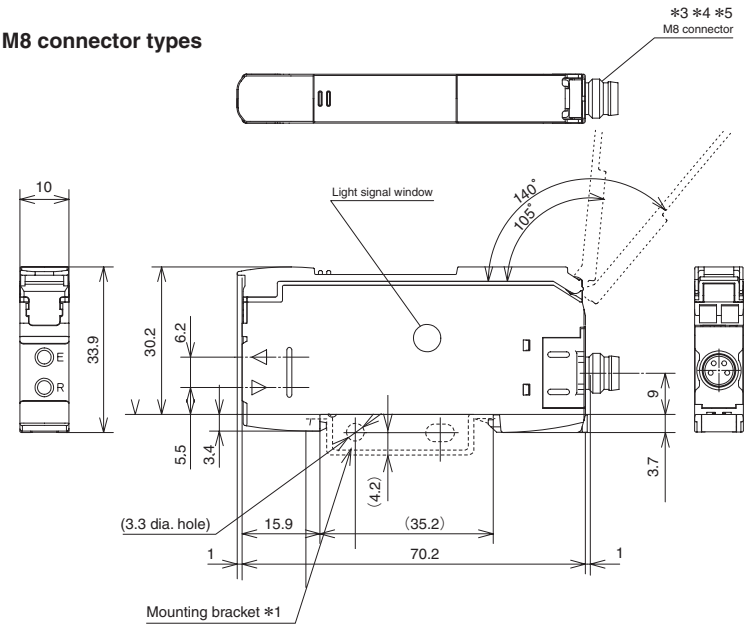
∗3. Oil-resistant cable.
2-core: **AG06-5S, AG08-5S, AG11-5S**
3-core: **AG00-1S/2S/3S/4S, AG04-5S, AG07-S**
4-core: **AG01-1S/2S/3S/4S, AG06-3S, AG08-3S, AG11-3S**
5-core: **AG02-1S/2S, AG03-1S/2S, AG04-3S, AG09-3S**
For the above units: outer diameter 4.2, insulator diameter 1.2, and nominal cross-section 0.2mm^2.
Sheath color is gray.

1-core: **AG00-5S/6S, AG07-5S**
Outer diameter 2.6, insulator diameter 1.2, nominal cross-section 0.2mm^2. Sheath color is gray.

∗4. Female connector structure for attaching a reduced wiring connector(for both main unit and expansion unit).

∗5. Reduced-wiring type expansion unit has a connector structure (male) for attaching additional units.

M8 connector types



Notes:

∗1. Mounting bracket sold separately (catalog listing: **HPX-PA04**).
When installing with the mounting bracket, mounting flush against the wall is not possible if a cable plug with an outer diameter larger than 10mm is used.

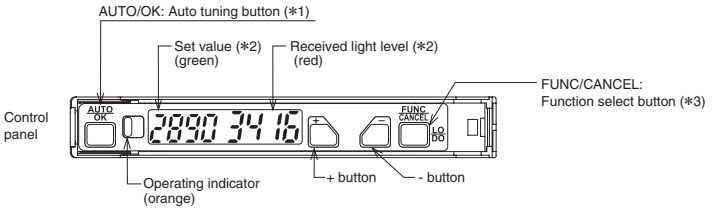
2. Materials.
Case: PC resin, black
Control panel cover: PC resin, gray transparent
Mounting bracket: Stainless steel plate

∗3. Please use the M8 connector or 8 dia. snap-in connector / female 4 contacts(IEC 61076-2-101).

∗4. Screw the coupring by hand.(0.3 to 0.4N•m)

∗5. Contiguous side-by-side mounting of multiple units in a single line is not possible if a cable plug with an outer diameter larger than 10mm is used.

NAMES OF PARTS

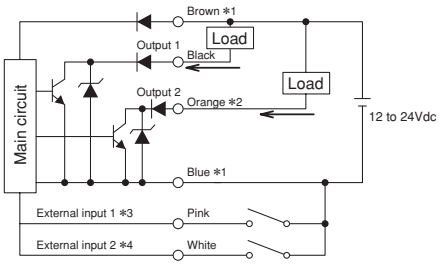


∗1: This button is also used as the SET button during setup.
∗2: Display can be set by selecting a display type in the function selection menu.
∗3: This button is also used for LO/DO setup or cancellation.

WIRING DIAGRAM FOR AMPLIFIER

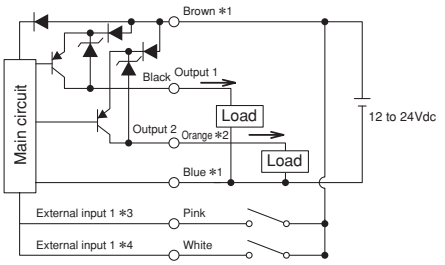
Preleaded types

● Input/output circuit and connection NPN type



∗1. Power to expansion units is supplied through the main unit.
∗2. **HPX-AG02/03/06/08-□S** only.
∗3. **HPX-AG01/02/03/04/09/11-□S** only.
∗4. **HPX-AG09-3S** only.

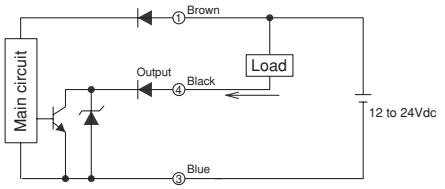
● Input/output circuit and connection PNP type



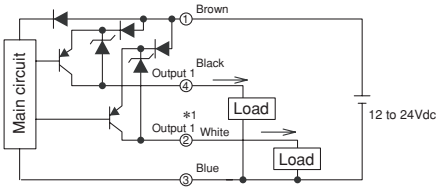
∗1. Power to expansion units is supplied through the main unit.
∗2. **HPX-AG02/03-□S** only.
∗3. **HPX-AG01/02/03/09-□S** only.
∗4. **HPX-AG09-4S** only.

M8 connector types

● Input/output circuit and connection NPN type (**HPX-AG00-1S-CT**)

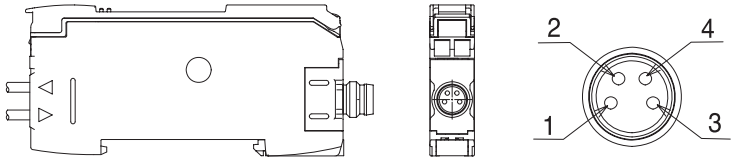


● Input/output circuit and connection PNP type



∗1. **HPX-AG06-2S-CT** only.

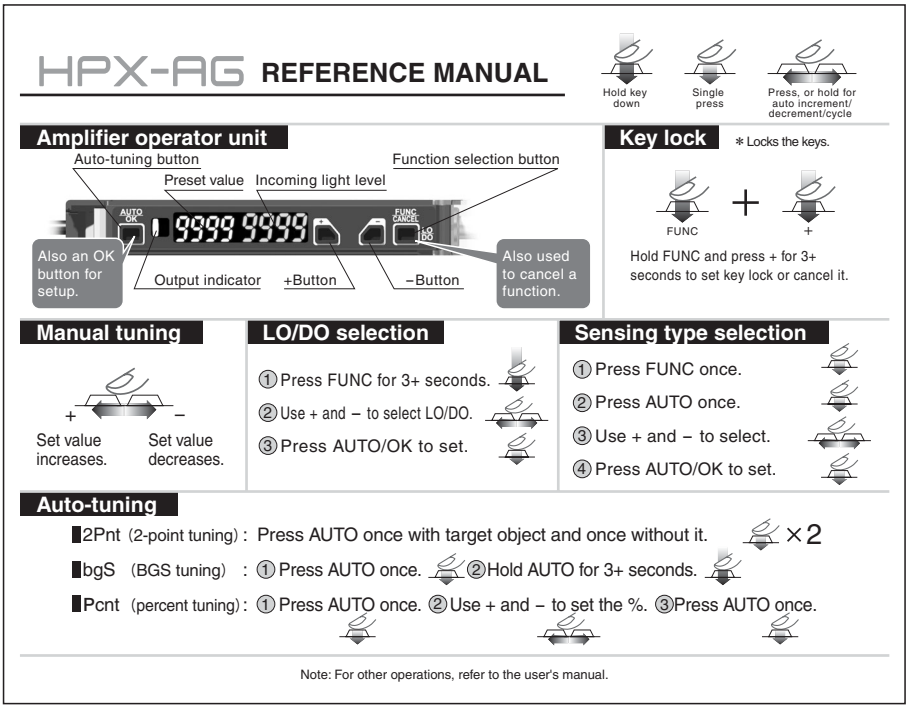
M8 connector contact arrangement



HPX-AG REFERENCE MANUAL

Frequently used operations are summarized on this card. For more detail, refer to the user's manual included with the **HPX-AG** digital fiber-optic sensor.

Peel-off reference stickers are also available in Japanese, English or Chinese.



HANDLING

1. Handling precautions

- Output is disabled upon power-up for approx. 200ms until the unit stabilizes.
- When used in an environment with much dust, be sure to take countermeasures to keep dust away from the sensor head by using a sealed case or air purge.
- Use a cover or change the mounting direction to ensure the sensor's correct operation if interference from ambient light is considerable.
- Even when oil-resistant cable is used, do not use in a location subject to continuous splashing by water or oil, or where the unit is dipped in liquid. Ensure that the end of the cable is not subject to splashing by water or oil.
- Water or oil splashed on the fiber head may cause incorrect operation. Shield the sensor head to prevent direct splashes.
- Do not use where exposed to chemicals (organic solvents, acids, alkalis, etc.)
- To clean the sensor head, wipe lightly with a soft, clean cloth. Do not use an organic solvent such as benzine or paint thinner.
- Pulling with excessive force may break the cable. Do not apply a force of more than 50N.
- Do not bend the part of the cable nearest to the amplifier beyond the bend radius of 30mm. Avoid continuous bending stress.
- The detection distance or display value may vary depending on variations in the individual amplifier, installation circumstances, and/or type of fiber unit.

2. Wiring

- If an extension is necessary, use cable at least 0.3mm^2 in dia. and at most 100m long.
- If the wires of photoelectric sensor are laid in the same conduit as high-voltage or power lines, inductance may cause malfunction or damage. Isolate the photoelectric sensor's cable or lay it in a separate conduit.
- When using a commercially available switching regulator, ground the frame ground and ground terminals. If used without grounding, switching noise may cause malfunction.
- When using a load which generates an inrush current above the switching capacity, such as a capacitive load or incandescent lamp, connect a current-limiting resistor between the load and the output terminals. (Otherwise, the output short-circuit protection function will be activated.)

Before selecting or using a model, please carefully read the specification sheets and user's manual.